GEOGRAPHIC DISTRIBUTION OF THE RHESUS AND THE BONNET MONKEYS IN WEST CENTRAL INDIA[1]

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(With four text-figures)

INTRODUCTION

Two species of macaques, namely the bonnet macaque (*Macaca radiata*) and the rhesus macaque (*Macaca mulatta*), occur in West Central India. The distribution of the bonnet macaque is confined to the southern peninsula, whereas that of the rhesus is widespread throughout northern India. It is well known that the rivers the Tapti and the Godavari form boundaries which separate the two species allopatrically (Fiedler 1956, Prater 1965). However, these two rivers are not effective barriers in limiting the distribution of hanuman langurs (*Presbytis entellus*) which inhabit almost the whole of India. The rivers never join each other and the minimum distance between them is about 130 km. Little field research has been conducted on the distribution of macaques in this region. The area sandwiched between the two rivers was the focus of our field-survey. The purpose was to clarify the present distribution-patterns of the above-mentioned species of macaques and hanuman langurs, and to elucidate their group composition and habitat ecology.

METHODS

In the States of Maharashtra, Gujarat and Madhya Pradesh, a vehicle (jeep) was used for transportation of personnel during the survey. Information on the general distribution of the two species of macaques was collected from the office of the Chief Conservator of Forests in each State, and several Divisional Forest Offices were selected as places worth visiting. Interviews were conducted in each area with local forest officials and non-official persons. The questions asked were related to the occurrence or absence of different types of species and, when their occurrence was confirmed, on the place, time and number of animals seen. Regarding the type of species, three different photographs of bonnet macaque, rhesus macaque and hanuman langur, respectively were shown during interviews in order to avoid confusion. Most of the people interviewed were able to distinguish the 'black-face monkey' (= hanuman langur) from the 'red-face monkey' (= bonnet and rhesus), although they were not capable of distinguishing bonnet macaques from rhesus monkeys. Queries were also addressed to forest officials regarding dominant tree-species and the forest-conditions prevailing in each area.

The survey-period conducted by jeep lasted for 101 days from August 17 to October 15, 1972 and again from December 5 to January 14, 1973. The total area covered was 9900 km. Besides this survey, the senior author made a preliminary survey in the State of Andhra

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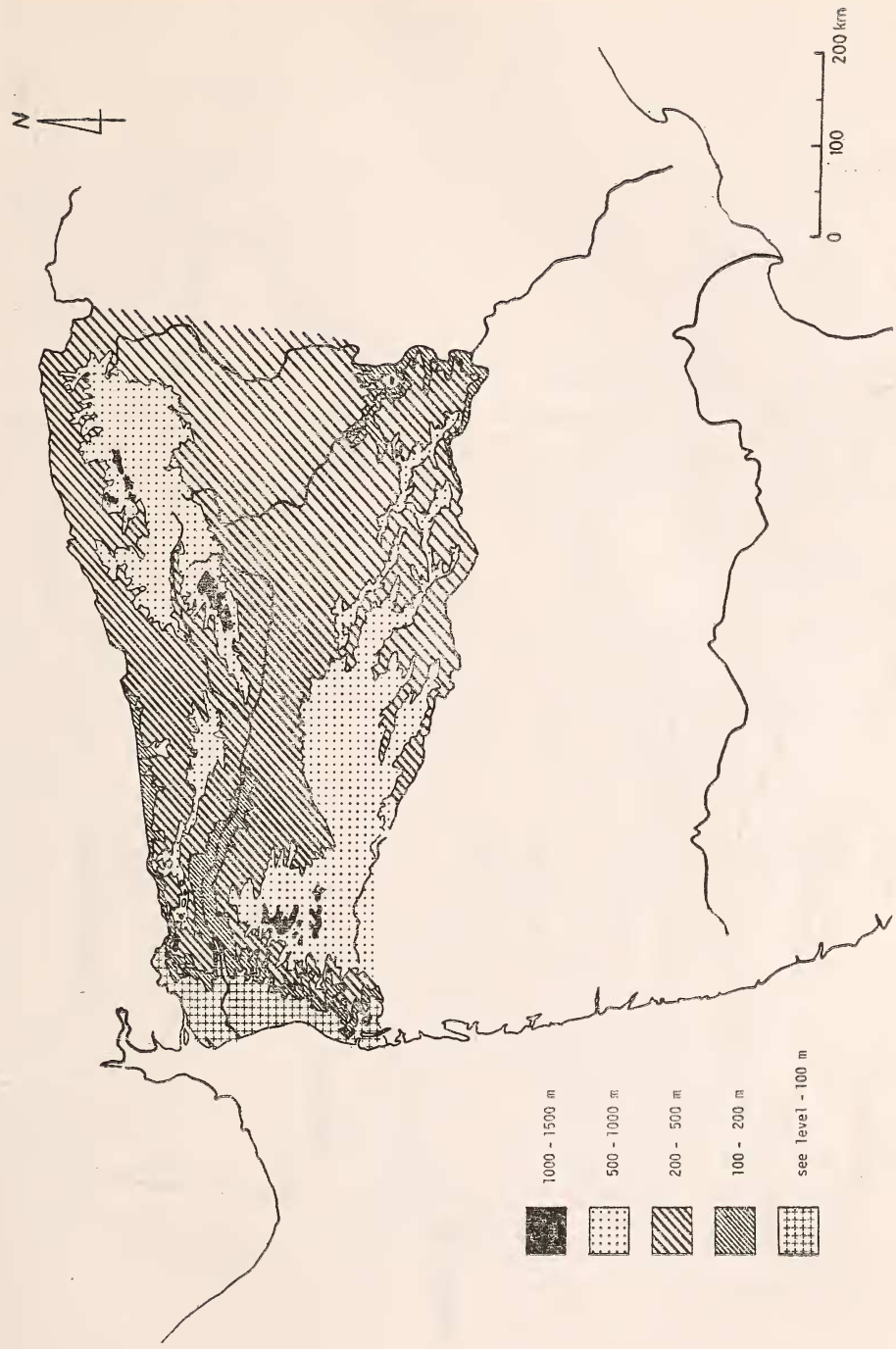

Fig. 1. Relief of the main study area.

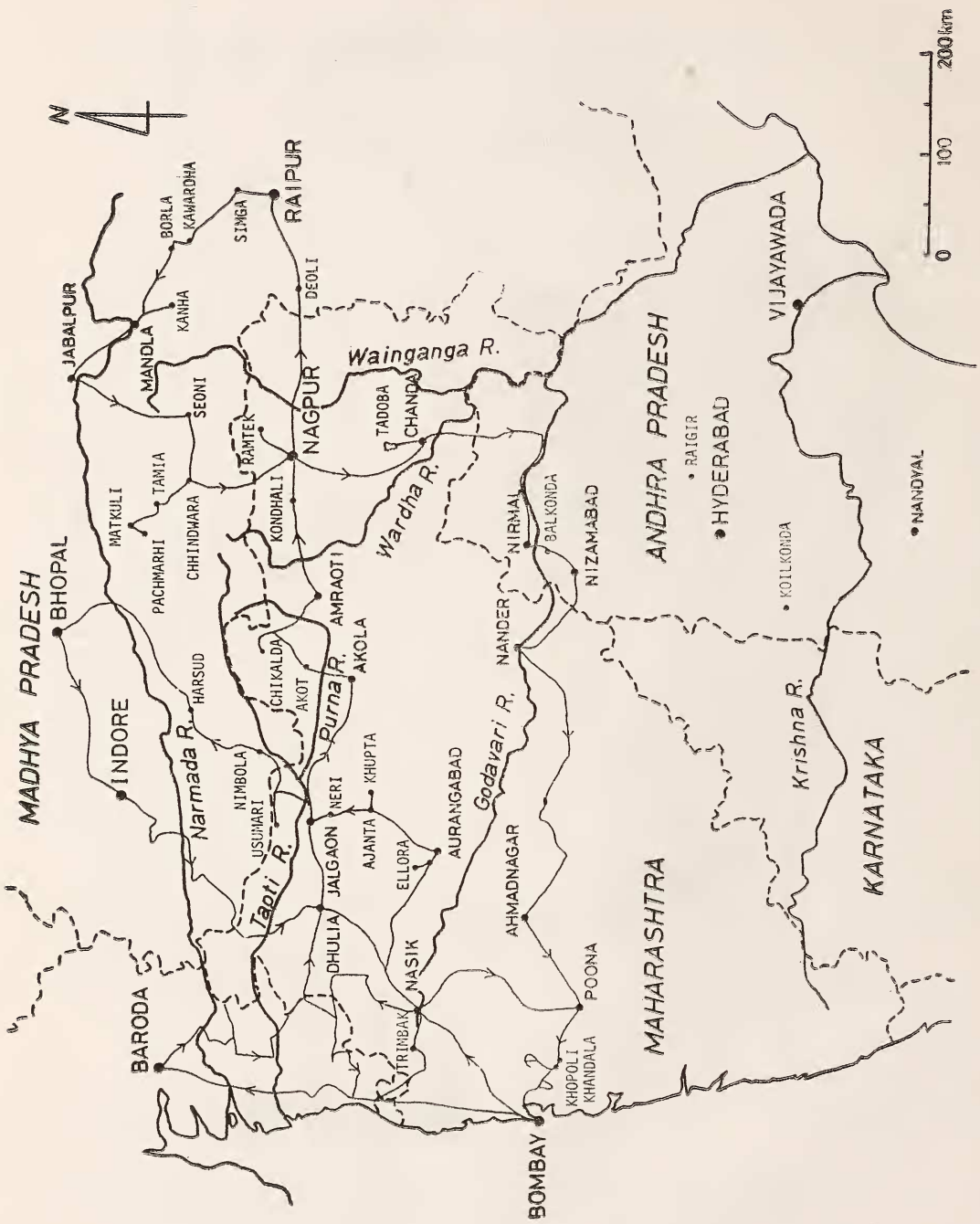

Fig. 2. Survey-route traversed by jeep.

Pradesh for 23 days from November 6 to November 28, 1972, using local transport.

Study area

Although the study area covered southern Gujarat, Maharashtra, southern Madhya Pradesh and Andhra Pradesh, detailed survey was conducted only in the region surrounded by the Narmada, Wainganga and Godavari rivers. The relief of this area and the survey-route traversed by jeep is shown in Figs. 1 and 2. As shown in Fig. 1, the area consisted of four major divisions based on relief, namely, the Satpura range, the Konkan coastal strip, the Western Ghats and the Deccan Plateau. Forming a physical boundary between North India and the Deccan Plateau, the source of the river Narmada is located in an area of the East-Central Highlands known as Maikala range. The total length of the Narmada, the fifth longest river in India, is about 1310 km. The Tapti flows for a distance of about 670 km from east to west, originating from the Satpura range. The Godavari, the fourth longest river of the country, runs across the Deccan Plateau from the Western Ghats. One of the sources of this river is located on the side of a hill named Trimbakeshwar, about 80 km from the shore of the Arabian sea. Another source is at Kalsubai, a peak 1646 m above the sea level and the highest in Maharashtra State. The total length of the Godavari is about 1465 km. The Wainganga originates near the town of Seoni in the Satpura range and flows for about 546 km before joining the Wardha. The Pranhita, at the confluence of the Wainganga and the Wardha, is a tributary of the Godavari.

According to the classification proposed by Champion and Seth (1968), 16 climatic forest types can be differentiated in India. The following six forest types occurred in the main study area: (1) Evergreen forest. Found along the western face of the Western Ghats, the extent of this type of forest is very limited. (2) Semi-evergreen forest. This type of forest, also of limited distribution, occurs mostly on the Western Ghats between the evergreen and the moist deciduous forests.
(3) Moist deciduous forest. Found both in the hilly areas of Western Ghats, Chikalda, Pachmarhi, as well as in the plains of Chanda, in a rainfall zone of 1500 to 2000 mm. In general, the height of this type of forest ranges from 30 to 36 m.
(4) Dry deciduous forest. This type of forest is common throughout the Deccan Plateau. The typical annual rainfall ranges from 1000 to 1300 mm. The height of this type of forest varies from 13 to 20 m.
(5) Thorn forest. Found throughout the dry peninsular tract of Central India, this type is characterized by the abundance of *Acacia* species reaching 6 to 9 m in height.
(6) Littoral and the swamp forests. Found along the coastal area of the sandy beach and the river mouth, it also has a limited distribution. It is characterized by various species of mangroves.

Results

Distribution and composition of hanuman langur troops and groups:

As shown in Fig. 3, a total of 59 troops[4] and groups[5] were observed during the survey-period. Hanuman langurs were distributed throughout the study area, although the population density was not uniform within this range. The species inhabited moist deciduous forest, dry deciduous forest and even thorn forest, but, were very rarely found in evergreen or semi-evergreen forests along the

[4] Troop = bisexual. [5] Group = unisexual.

Fig. 3. Localities of three species of monkeys.

Western Ghats where macaques were of fairly common occurrence. Data on size and composition, available only for 24 troops and three unisexual male groups (= all-male groups), are listed in Table 1, together with the date of observation, locality number and the name of the place. Of the 24 troops, six (25%) contained more than two adult males each

TABLE 1

COMPOSITION OF TROOPS AND ALL-MALE GROUPS OF HANUMAN LANGURS

Date	Locality No.*	Place	Adult Male	Adult Female	Sub-Adult Male	Juvenile Male	Juvenile Female	Infant Male	Infant Female	Total
1972										
Aug. 23	1	Daulatabad	5	13	1		10			29
29	2	Ellora	1	13		6		5		25
30	3	Ajanta	3	22		6		1		32
31	4	Khupta	1	10			6	3		20
,,	5**	,,	9			9				18
Sep. 2	6	Neri	1	12	1	11		3		28
7	7	Akot	1	9			2			12
,,	8**	,,	9			3				12
,,	9	,,	1	14		1	10	1	4	31
10	10	Chikalda	1	3		1	1	2		8
12	11**	,,	7			2				9
13	12	Kondhali	1	10			7	2		20
14	13	Ramtek	1	20		15		8		44
,,	14	,,	1	9			3	1	1	15
,,	15	Ramtek-Nagpur	2	10		1	2			15
,,	16	,,	1	6			1	2		10
,,	17	,,	1	15		5	4	7		32
17	18	Deori-Durg	1	7		1	3		2	14
,,	19	,,	3	13			5			21
,,	20	,,	1	23		8		10		42
19	21	Simga	1	10			4	2		17
,,	22	Kawardha	3	10	1		3	2		19
			2	7	1		2	2		
			1	3			1			
,,	23	Borla	4	10	1		5			20
Oct. 2	24	Chanda	1	9		2	6	5	3	26
Dec. 26	25	Usumari, Pal	1	5				3		9
27	26	Nimbola	1	6		5		1		13
28	27	Harsud-Harda	1	4		3				8
all-male group		(3 groups)	25			14				39
			(8.33)			(4.67)				(13)
bisexual troop		(24 troops)	38	263	4	11	54 72	9	49 10	510
			(1.58)	(10.96)	(0.17)	(5.71)		(2.83)		(21.25)
TOTAL			63	263	4	151		68		549

** All-male group * See Figure 3.

("multi-male troops") and the remaining eighteen (75%) included only one adult male each ("one-male troops"). At the outskirts of the town Kawardha (Locality No. 22), two sub-troops were once observed resting separately in two trees about 50 metres away from each other. One sub-troop was composed of two adult males, seven adult females, one subadult male, two juvenile females and two infants whereas the other was one-male subtroop, consisting of one adult male, three adult females and one juvenile female. Finally, the smaller sub-troop joined the bigger one resulting in the formation of one multi-male troop.

The average number of individuals per troop was 21.25, consisting of 1.58 adult males (7.5%), 10.96 adult females (51.6%), 0.17 subadult male (0.8%), 5.71 juveniles (26.9%) and 2.83 infants (13.3%). Adults accounted for about 59 per cent of the total troop members. The mean value of the socioeconomic sex ratio, i.e. number of adult females per one adult male, for these 24 troops was *c.* 6.9. As in unisexual male groups, the average number of individuals per group was 13.0 comprising 8.33 adult males (64.0%) and 4.67 juveniles (36.0%).

Distribution and composition of bonnet monkey troops:

Bonnet monkeys were confined to the well-forested narrow belt along the Western Ghats (Fig. 3). South of the Tapti, the northernmost limit for bonnet was 21°05'N, 73°35'E near Songadh in Gujarat State. They occurred in the moist deciduous and the dry deciduous forests, but never in the dry scrub or thorn forests where the height of the trees does not exceed 50 feet. In some areas, such as Dangs and Dharampur forests of Gujarat State, many troops of bonnet monkeys still exist. Adjacent to these forests, Surgana, Peint and adjoining forests belts extend upto East Nasik, West Nasik and West Dhulia Divisions of Maharashtra State. However, due to the poorer forest conditions, the population density in these areas does not seem to be as high as in Dangs and Dharampur.

During the survey, a total of eight troops of bonnet monkeys were observed in all. One troop inhabiting the Elephanta island in the Bombay harbour, for which the information available is incomplete, is also included in this treatment of the results. Excepting this troop, complete counts were made for the other seven. Table 2 shows the composition of the latter troops; the average number of individuals per troop was 25.7 which included 4.29 adult males (16.7%), 8.14 adult females (31.7%), 0.714 subadult male (2.8%), 3.43 juvenile males (13.3%), 4.71 juvenile females (18.3%) and 4.29 infants (16.7%). Adults accounted for about 48.3 per cent of the total number of troop members. The mean value of socioeconomic sex ratio was *c* 1.9.

Changes in troop membership were recorded for two troops from Trimbak (Locality No. 1) and Khandala (Locality No. 2), respectively. On August 19th, the Trimbak troop (Locality No. 1) contained 25 individuals but by December 17th, i.e. four months later, one subadult male joined and four infants disappeared, while there were two births. The Khandala troop contained 25 individuals on October 13th, but on January 13th, i.e. three months later, one new-born infant was seen in this troop. Besides the above mentioned births, four other new-born were seen at Matheran in January.

Distribution and composition of rhesus monkeys:

Rhesus monkeys occurred along the Satpura range in the region north of the river Tapti and its tributary, the Purna. North of of the Tapti, the westernmost limit for the

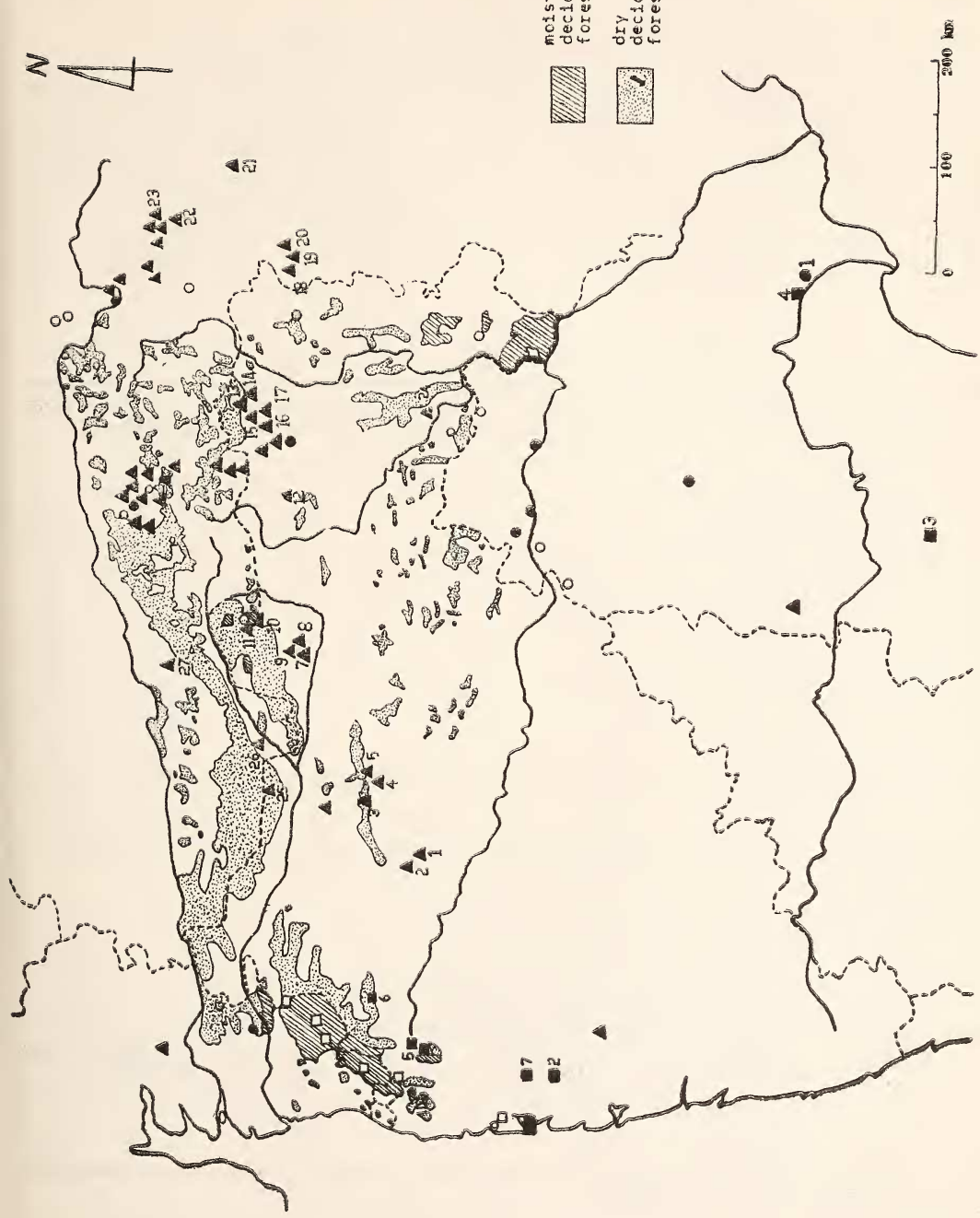

Fig. 4. Distribution of the moist deciduous and the dry deciduous forests in main study area.

distribution of rhesus was 21°20′N, 73°30′E in Kherwada forests of Gujarat State. They also occur in east Maharashtra and in north Andhra Pradesh as far south as 16°30′N, 80°35′E, crossing the river Godavari (Fig. 3). The names of the places which were noted to be inhabited by free-ranging rhesus monkeys are Balkonda, Alisagar (about 5 km from Nizamabad), Raigir and Vijayawada. Monkeys in these localities must have been the artificially introduced ones. Besides these monkeys, one more troop inhabited the Borivli National Park about 35 km north of Bombay. This is also an artificially introduced troop.

During the survey period, nine troops of rhesus monkeys were encountered. However, complete counts were made only for one habituated troop. Near a temple in Vijayawada (Locality No. 1 in Table 3), one rhesus monkey troop, occurred together with a troop of bonnet monkeys (Locality No. 4 in Table 2). As shown in Table 3, this

TABLE 2

TROOP COMPOSITION OF BONNET MONKEYS

Date	Locality No.**	Place	Adult Male	Adult Female	Sub-Adult Male	Juvenile Male	Juvenile Female	Infant Male	Infant Female	Total
1972										
Aug. 19	1	Trimbak	3	9		3	5	5		25
Oct. 13	2	Khandala	5	4	2	5	6	1	2	25
Nov. 17	3	Nandyal	3	4		4	2	1	1	15
21	4	Vijayawada	3	6	2	3	3	1	3	21
Dec. 17	5	Trimbak	7	14		2	8	2	4	37
17	1	Trimbak	3	9	1	3	5	2*	1	24
18	6	Vani	5	9		1	5	1	2	23
1973										
Jan. 12	7	Matheran	4	11		6	4	1	4*	3	33
13	2	Khandala	5	4	2	5	6	1	1*	2	26
TOTAL			30 (4.29)	57 (8.14)	5 (0.714)	24 (3.43)	33 (4.71)	7 (1.0)	7 (1.0)	16 (2.29)	179 (25.7)

* New-born Infant
** See Figure 3.

TABLE 3

TROOP COMPOSITION OF RHESUS MONKEYS

Date	Locality No.**	Place	Adult Male	Adult Female	Sub-Adult Male	Juvenile Male	Juvenile Female	Infant Male	Infant Female	Total
1972										
Nov. 21	1	Vijayawada	4*	5		6	1	3		19*

* The number includes one bonnet monkey
** See Figure 3.

TABLE 4

FOREST TYPES OCCURRING IN MAHARASHTRA STATE
NAME OF FOREST TYPE: (3B/C1) SLIGHTLY MOIST AND MOIST TEAK FOREST

Forest Division or Sub Division	East Nasik	West Nasik	Dah-anu	Thana	Shaha-pur	Kolaba	Roha	Bhan-dara	Chand-rapur	Yeot-mal	South Chanda	Alla-pall
Tectona grandis	×	×	×	×	×	×	×	×	×	×	×	×
Terminalia tomentosa	×	×	×	×	×	×	×	×	×	×	×	×
Anogeissus latifolia	×	×				×	×	×			×	
Dalbergia latifolia	×					×	×			×		×
Adina cordifolia	×	×	×	×	×	×	×		×			×
Lagerstroemia parviflora	×					×	×	×	×		×	×
Mitragyna parvifolia	×	×	×	×	×					×	×	×
Pterocarpus marsupium	×		×	×	×	×	×	×		×	×	
Albizzia lebbek	×					×	×					
Albizzia procera	×											
Garuga pinnata		×				×	×					
Lannea coromandelica		×				×	×					
Acacia catechu			×	×	×							
Holarrhena antidysenterica			×	×	×							
Dillenia pentagyna			×	×	×							
Careya arborea			×	×	×	×	×					
Butea monosperma			×	×	×							
Diospyros melanoxylon			×	×	×			×	×		×	×
Carissa carandas			×	×	×							
Terminalia paniculata						×	×		×			
Salmalia malabarica						×	×					
Terminalia belerica						×	×					
Grewia tiliaefolia						×	×					
Xylia xylocarpa								×			×	×
Bassia latifolia								×		×	×	×
Dendrocalamus strictus								×	×			×
Boswellia serrata								×				
Schleichera trijuga										×		

troop consisted of nineteen individuals. However, the highest-ranking adult male of this troop was a bonnet which may have immigrated from the troop of bonnet monkeys living in the same place. No hybrids of bonnet and rhesus could be seen, suggesting that the bonnet male had immigrated to this troop fairly recently.

Distribution-patterns and forest-conditions:

Characteristic species of trees from slightly moist and moist teak forests occurring in each Forest Division or Subdivision of Maharashtra State are shown in Table 4 and typical species of trees from dry deciduous forest are shown in Table 5. From these tables it is evident that teak (*Tectona grandis*) and ain (*Terminalia tomentosa*) are abundant throughout the moist deciduous and the dry deciduous forests. Distribution of these forests, surrounded by the rivers Narmada, Wainganga and Godavari, is shown in Fig. 4. Occurrence or absence of two species of macaques in different forest-types of each forest division of

Maharashtra State is summarized in Table 6. From this table, it is clear that the incidence of the two species of macaques is highly dependent on the presence or absence of moist deciduous or mixed deciduous forest with trees exceeding 50 feet (*c* 15 m) in height.

Discussion

Although hanuman langurs occupy a broader spectrum of habitats than macaques (Vogel 1977), data collected during the survey period suggest that macaques and langurs have different habitat preferences. While macaques are limited to areas with moist deciduous and dry mixed deciduous forests, langurs inhabit dry mixed deciduous and dry scrub forests. In a broader sense, it seems likely that the places where the population of macaques is dense, langurs are less common. Absence or paucity of hanuman langurs in the areas along

Table 5

Forest types occurring in Maharashtra State (I)
Name of Forest type: (5A/C1) Dry teak-bearing forests

Forest Division or Sub-Division	East Nasik	North Dhulia	West Dhulia	Jalgaon	East Melghat	West Melghat	Amra-vati	Buld-hana	West Yeot-mal	Buldhana & Akola
Tectona grandis	×	×	×	×	×	×	×	×	×	×
Terminalia tomentosa	×	×	×		×	×	×	×	×	
Ougeinia oojeansis	×							×	×	
Dalbergia latifolia		×	×		×	×	×	×		
Pterocarpus marsupium		×	×					×		
Adina cordifolia		×	×		×	×	×			
Grewia tiliaefolia		×								
Lannea coromandelica		×								
Salmalia malabarica			×							
Acacia catechu			×	×						
Sterculia urens			×							
Diospyros melanoxylon			×					×	×	
Bassia latifolia			×							
Boswellia serrata		×		×				×		×
Anogeissus latifolia				×				×	×	×
Hardwickia binata				×						
Emblica officinalis				×						×
Garuga pinnata				×						
Lagerstroemia parviflora					×	×	×		×	
Mitragyna parvifolia										×
Butea frondosa										×
Zizyphus jujuba										
Lannea grandis										
Acacia leucophloea										×
Buchanania latifolia										
Chloroxylon swietenia										
Cleistanthus collinus										

TABLE 5 (contd)

FOREST TYPES OCCURRING IN MAHARASHTRA STATE (II)
NAME OF FOREST TYPE: (5A/C1) DRY TEAK-BEARING FORESTS

Forest Division or Sub-Division	East & West Yeotmal	Wardha	Nagpur	Nagpur	Wardha	Rajura	South Chanda	West Chanda	South Chanda	Nanded
Tectona gradis	×	×	×	×	×	×	×	×	×	×
Terminalia tomentosa	×	×	×	×	×		×	×	×	×
Ougeinia oojeansis										
Dalbergia latifolia										
Pterocarpus marsupium				×	×				×	×
Adina cordifolia										
Grewia tiliaefolia										
Lannea coromandelica										
Salmalia malabarica						×	×	×		
Acacia catechu										
Sterculia urens										
Diospyros melanoxylon	×	×	×	×	×	×	×	×	×	×
Bassia latifolia										×
Boswellia serrata	×	×	×	×	×	×	×	×		×
Anogeissus latifolia	×	×	×	×	×	×	×	×	×	×
Hardwickia binata										
Emblica officinalis										
Garuga pinnata										
Lagerstroemia parviflora	×	×	×						×	×
Mitragyna parvifolia										×
Butea frondosa										
Zizyphus jujuba										
Lannea grandis		×	×						×	×
Acacia leucophloea									×	
Buchanania latifolia	×	×	×							
Chloroxylon swietenia						×	×	×		
Cleistanthus collinus						×	×	×		

the Western Ghats may due to the hunting by tribes and the predation by wild animals. Many tribes such as Bhil, Gond, Varli and Kokna live along the Western Ghats. According to the 1961 population census, the population of scheduled tribes in Maharashtra was 2,397,000. Within Maharashtra, the Bombay division contained 70.39 per cent of the 1961 scheduled tribes population. Krishnan (1971) reported that tribal hunting exterminated the langurs in Sholinghur within half-a-dozen years. It seems that it is easier to hunt langurs than to hunt macaques, due to the larger body sizes and the smaller home ranges of the former. At Kanha National Park of Madhya Pradesh, langurs are commonly captured by tigers (Schaller 1967). Tigers and leopards still occur in the well-forested areas along the Western Ghats, at least in Dangs of Gujarat State. In connection with habitat preference,

TABLE 6

OCCURRENCE OF ABSENCE OF TWO SPECIES OF MACAQUES IN EACH FOREST DIVISION OF MAHARASHTRA STATE, WITH SPECIAL REFERENCE TO FOREST TYPES

Forest Circle & Division	Total forest area (km²)	Forest area with trees 50+ ft. high (km²)	%of forest, to total forest area with trees 50+ft. high	Forest type			Occurrence or non-occurrence		Population density
				F1	F2	F3	bonnet	rhesus	
Region I									
THANA									
Dahanu	2269.66	863.84	38.1	+	+	–	+	–	low
Shahapur	1164.45	505.06	43.4	+	+	–	+	–	low
Thana	1166.32	552.90	45.0	+	–	–	(+)?	–	rare
Borivli	61.90			+	–	–	+	+*	rare
Kolaba	1763.40	178.88	10.1	+	–	–	(+)?	–	rare
Roha Sub-Dn.	1305.32	97.20	7.4	+	–	–	(+)?	–	rare
NASIK									
East Nasik	2251.09	746.32	33.2	+	+	–	+	–	low
West Nasik	1115.99	512.93	46.0	+	+	–	+	–	medium
North Dhulia	3027.06	382.86	12.6	–	+	–	–	(+)?	rare
West Dhulia	1698.45	267.13	15.7	–	+	–	(+)?	–	rare
Jalgaon	983.31	0	0	–	+	+	–	–	
Yawal	1103.43	116.55	10.6	–	+	–	–	(+)?	rare
POONA									
Poona	1179.62			(+)	+	+	–	–	
Satara	2398.38			–	+	+	–	–	
Kolhapur	2148.55	no data**		(+)	+	+	?	–	
Koyananagar Sub-Dn.	299.97			(+)	+	–	?	–	
Bhor Sub-Dn.	328.38			–	+	+	?	–	
Sawantwadi	376.52			(+)	–	–	?	–	
AURANGABAD									
Ahmednagar	1875.68	0	0	–	(+)	+	–	–	
Jannar (Ghod project)	460.78	0	0	–	–	+	?	–	

TABLE 6 (contd.)

Region II									
AURANGABAD									
Aurangabad	1097.61	0	0	–	(+)	+	–	–	
Nanded	1720.37	8.64	0.5	–	+	+	–	–	
Region III									
AMRAVATI									
East Melghat	1332.15	1305.00	43.2	(+)	+	–	–	+	medium
West Melghat	1689.76			(+)	+	–	–	+	medium
Amravati Sub-Dn.	649.12	0.90	0.1	–	+	+	–	(+)?	rare
East Yeotmal	1895.15	26.32	0.7	+	+	+	–	–	
West Yeotmal	1926.26			+	+	+	–	–	
Akola	874.74	1.49	0.2	–	+	+	–	–	
Buldhana	1567.43	1.00	0.1	–	+	+	–	–	
NAGPUR									
Nagpur	2779.01	60.97	2.2	–	+	+	–	(+)	rare
Wardha	890.35	7.48	0.8	–	+	+	–	–	
Bhandara	1904.83	168.46	8.8	+	+	–	–	+	low
Gondia	2373.92	47.48	2.0	–	+	+	–	(+)?	rare
CHANDA									
South Chanda	3251.60	4858.71	26.3	+	+	–	–	+	low to high
Allapalli	2599.30			+	–	–	–	+	low to medium
East Chanda	4689.71			–	+	+	–	+	low to medium
Central Chanda	1394.68			–	+	+	–	+	low to medium
West Chanda	2808.38			–	+	–	–	(+)?	rare
Bhamragarh	3731.79			–	+	–	–	(+)?	rare
Spl. Forest Dn.	31.22			no data	no data	no data	–	?	
Maharashtra State	66185.64	10710.12							

F1: moist deciduous, F2: dry mixed deciduous, F3: dry scrub.
* Introduced ** Details of stock-mapping not available, the area is mostly mixed forests not above 50 feet.

it may be possible to hypothesize that once the Nilgiri langurs (*Presbytis johnii*) inhabited the humid zone along the Western Ghats as far north as the river Tapti. Due to unknown reasons, they disappeared from this region leaving the vacated area available to langurs. Nilgiri langurs occupy the moist evergreen forest in the southern strip of the Western Ghats (Poirier 1970, Kurup 1977). Also, as suggested by Fooden (1975), lion-tailed macaques (*Macaca silenus*) must once have inhabited the rain forest along the whole part of the Western Ghats. With the recession of the rain forest and an increase in human population, lion-tailed macaques disappeared from this region and, consequently, the bonnet macaques might have filled the vacant habitat.

With respect to the distribution patterns of some macaques in peninsular India, Fooden (1976) suggested that *M. silenus* may have dispersed first followed by *M. radiata* and relatively recently *M. mulatta*. He also suggested that the inferred recent spread of the *fascicularis* (crab-eating macaque) group (including *mulatta*) may have been responsible for the reduction and disjunction of the range of the *sinica* (toque monkey) group (including *radiata* and *assamensis*. In accordance with this hypothesis, it may be possible to speculate on aspects of inter-specific competition between the bonnet and the rhesus. If it is assumed that the Narmada and the Wainganga functioned as an outer moat, and if the Tapti and the Wardha are considered as an inner moat, the present distribution-patterns indicate that the troops of rhesus monkeys crossed over these barriers through the 'gates' located at Mandla and Chindwara, moved *en masse* to the Western Ghats where advance troops of bonnet monkeys were stationed.

The present study revealed that not only the rivers Tapti and Godavari, but also the semi-arid zone of the Deccan Plateau of central India acted as barriers isolating the distribution ranges of the two species. The rhesus monkeys were artificially introduced to the region south of the river Godavari. In some places such as Borivli and Vijayawada, the bonnet monkeys and the rhesus monkeys are co-existing. North of the Tapti, the westernmost limit for the distribution of the rhesus is 21°20′N, 73°30′E in the Kherwada forests of Gujarat State, whereas south of the Tapti, the northernmost limit for the bonnet is 21° 05′N, 73°35′E near Songadh, Gujarat State. Bonnet monkeys are found mostly in hilly and sporadically forested areas of the Western Ghats. Hanuman langurs are distributed not only in the dry deciduous forests but also in the dry scrub forests of the Deccan Plateau which is not an effective barrier for making the distribution of this species isolated into populations like those of macaques.

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